



$H \rightarrow \gamma\gamma$: γ Efficiency & γ /Jet Separation

Preliminary Results

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OUTLINE

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MOTIVATION & GOALS

- To do an in-depth study of $H \rightarrow \gamma\gamma + 0, 1 \text{ and } 2 \text{ jets}$.
 - ◆ Reevaluation of gamma/jet rejection
 - ◆ Reexamination of reducible backgrounds.
 - ◆ As an example the main background to $H \rightarrow \gamma\gamma + 2 \text{ jets}$ is reducible.
- To compare our analysis with existing TDR.
 - ◆ To uncover effects produced by new detector layout.
- To search for new variables to optimize analysis.
- To develop new methods to improve photon efficiency and photon/jet separation.



DATA SETS USED

Data Sources:

DC1 ntuples.

Photons @ 20 GeV :

10000 events

002329.lumi02.recon.009.00001.hlt.pyt_h120...

Di-Jets @ 17 GeV:

251423 events (including Trigger block)

002000.lumi02.recon.010._.....hlt.pythia_jet17

Luminosity:

$2 \times 10^{33} \text{ cm}^{-2}\text{s}^{-1}$ (approximately 4.6 minimum bias events added per bunch crossing.)



PRESELECTION & OFFLINE CUTS

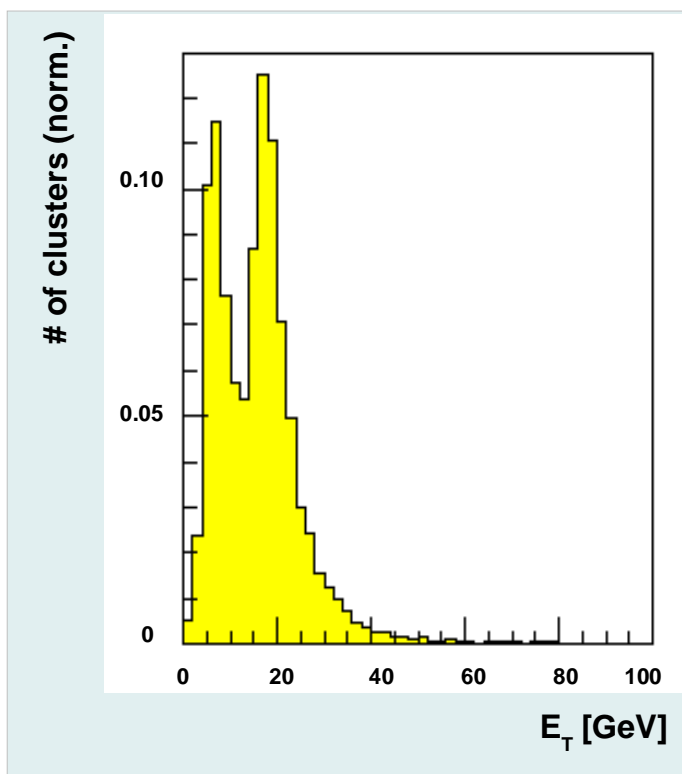
Preselection Cuts	Photons		$E_{T1} > 40 \text{ GeV} \ \& \ E_{T2} > 25 \text{ GeV}$
	Jets		$E_T > 17 \text{ GeV} \ \& \ \text{LVL1}$
Offline Cuts	Hadronic	H	$E_T(\text{Had})/E_T(\text{EM})$
	Second Sampling	2S_a	$E_2(3 \times 7)/E_2(7 \times 7)$
		2S_b	Corrected shower width using 3×5 cells in η .
	First Sampling	1S_a	Fraction of EM energy found in 1 st sampling of EM calorimeter.
		1S_b	Energy of 2 nd maximum.
		1S_c	Energy of strip where second maximum is found minus the energy of the valley between the two maxima.
		1S_d	Corrected shower width using three strips.
		1S_e	Fraction of energy outside the shower core in η



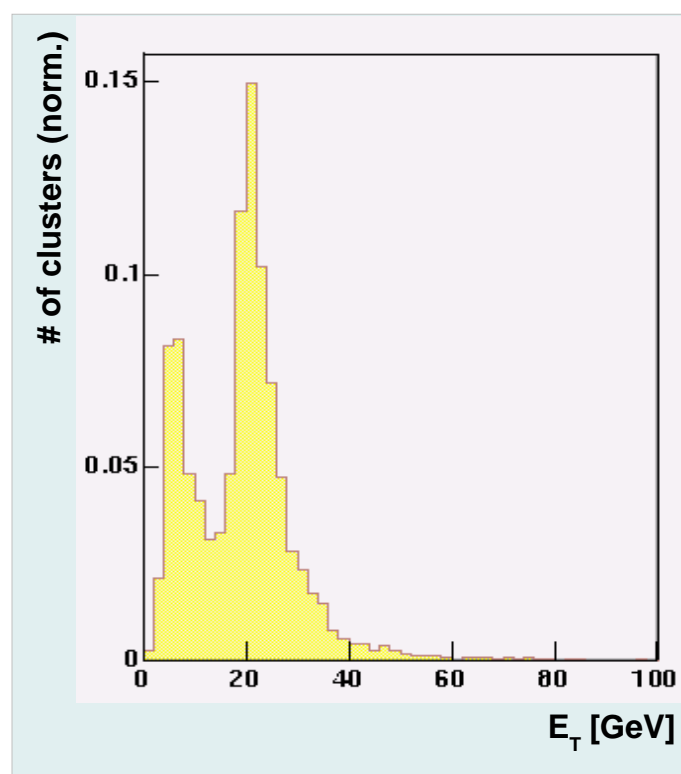
JET DISTRIBUTIONS

(Jets Surviving LVL1)

TDR



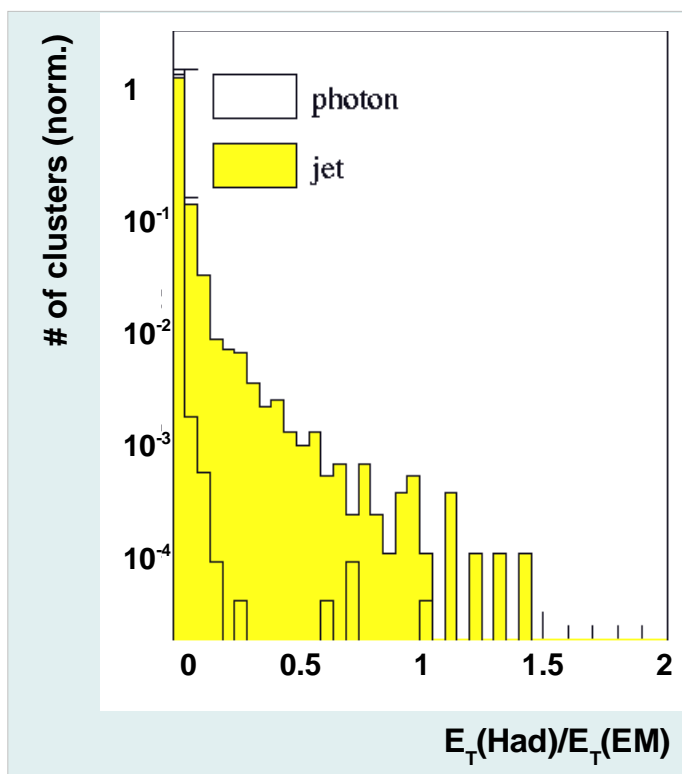
DC1



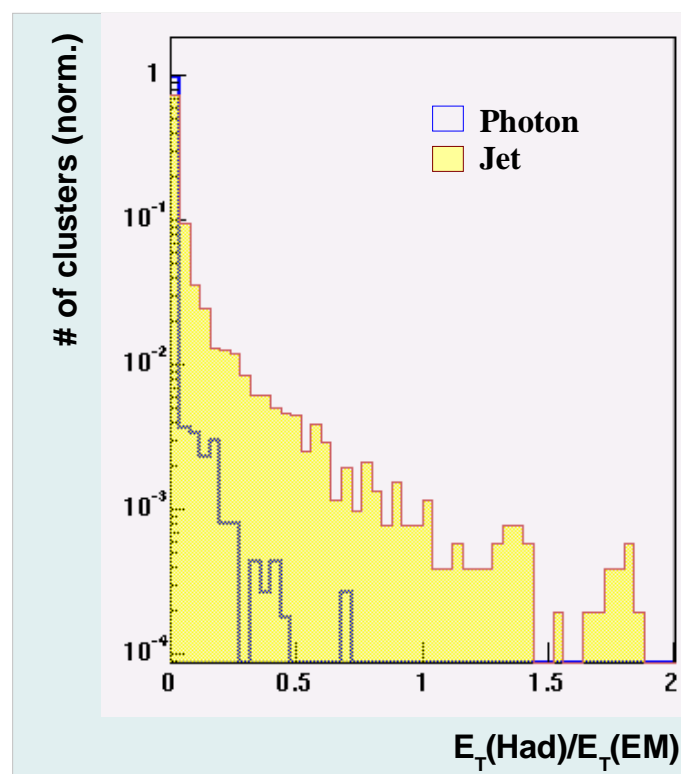


HADRONIC LEAKAGE

TDR



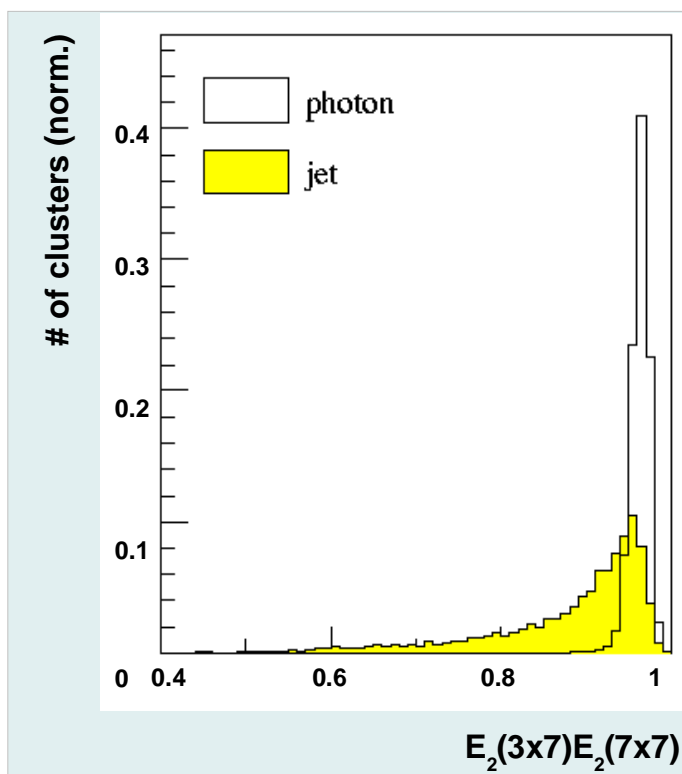
DC1



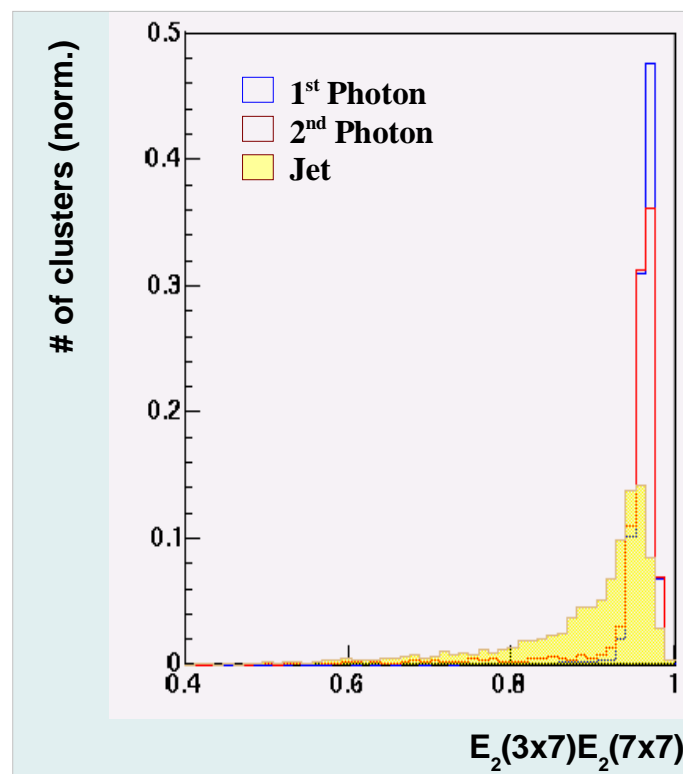


$$E_2(3 \times 7)/E_2(7 \times 7)$$

TDR



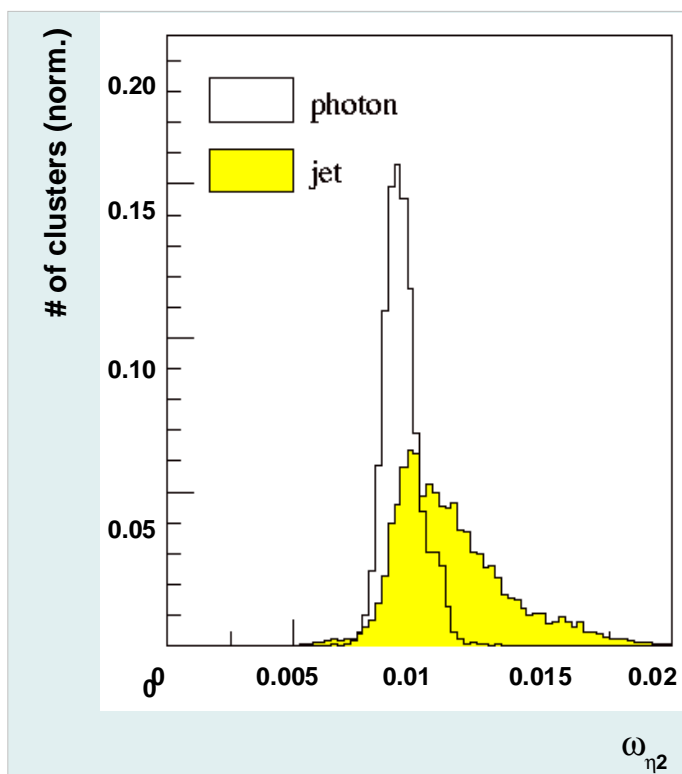
DC1



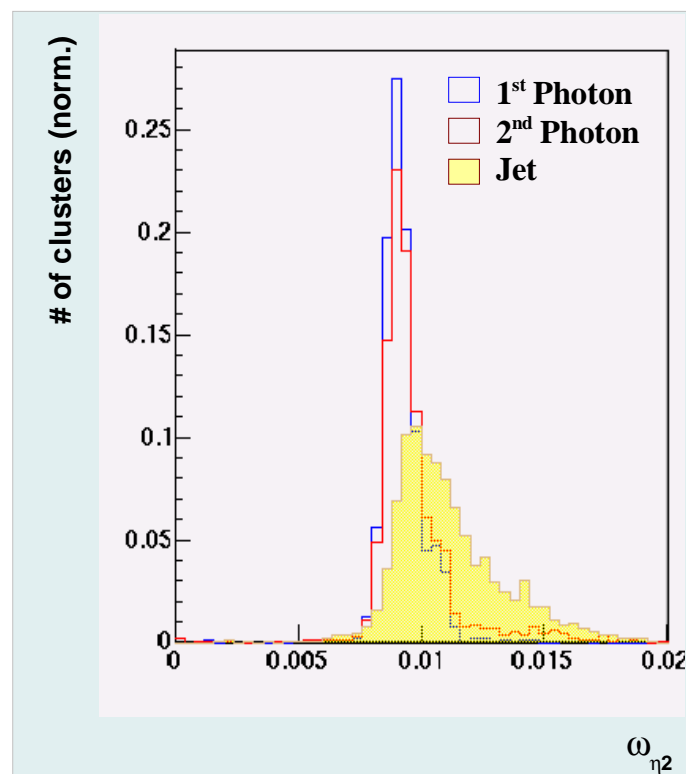


CORRECTED WIDTH IN η

TDR



DC1





DEFINITIONS

$$\text{Photon Efficiency} := N_{\text{Accepted Photons}} / N_{\text{Total}}$$

$$\text{Jet Rejection}^{**} := N_{\text{ATLFAST Jets}} / N_{\text{Accepted Jets}}$$

$N_{\text{ATLFAST Jets}}$ is normalized to the number of events prior to the particle level filter.

****** Jet rejection with respect to jets observed in ATLFAST.



CUT VALUES

Cuts Applied									Photon Efficiency (%)
η Ranges	Hadronic	Second Sampling		First Sampling					
	h <	2S_a >	2S_b <	1S_a >	1S_b <	1S_c <	1S_d	1S_e	
$0.00 < \eta < 0.75$	0.042	0.91	0.0118	0.42	0.30	0.28	0.36	0.80	84.4
$0.75 < \eta < 1.37$	0.042	0.92	0.0111	0.42	0.24	0.20	0.36	0.65	84.6
$1.52 < \eta < 1.80$	0.020	0.93	0.0111	0.42	0.24	0.20	0.31	0.68	84.6
$1.80 < \eta < 2.00$	0.040	0.92	0.0116	0.42	0.24	0.20	0.36	0.70	84.5
$2.00 < \eta < 2.47$	0.057	0.93	0.0112	0.35	0.26	0.29	0.36	0.65	84.5
$0.00 < \eta < 2.47$	0.059	0.82	0.0220	0.12	0.50	0.49	0.50	0.80	84.5



RESULTS

Cuts for $H \rightarrow \gamma\gamma$ at Low Lumi

	Photon Efficiency (%)		Jet Rejection (Rate)	
	TDR $17 < E_T < 23 \text{ GeV}$	DC1 $E_{T1} > 40 \text{ GeV}$ & $E_{T2} > 25 \text{ GeV}$	TDR $17 < E_T < 23 \text{ GeV}$	DC1 $17 \text{ GeV} < E_T$
LVL1	100	100	76	289
Hadronic Calo	95.7 (95.7)	93.5 (93.5)	130 (1.8)	378 (1.3)
EM Calorimeter				
2 nd Sampling	90.2 (94.3)	88.4 (94.5)	390 (2.9)	777 (2.1)
1 st Sampling	85.7 (95.0)	84.5 (95.5)	1050 (2.7)	1433 (1.8)

■ Jet Rejection without LVL1 = 429.



CONCLUSIONS & FUTURE PLANS

- Jet rejection has increased by a factor of 3.8 at Level1.
- Approximately 37 % higher jet rejection with present layout.
 - ◆ Still not clear if this is due to LVL1 or to cut differences with respect to TDR.
- To further investigate the use of new variables as a means of improving the existing results.
- To exploit the effectiveness of neural networks.
- To include in the analysis the differences brought by the existence of converted and un-converted photons.